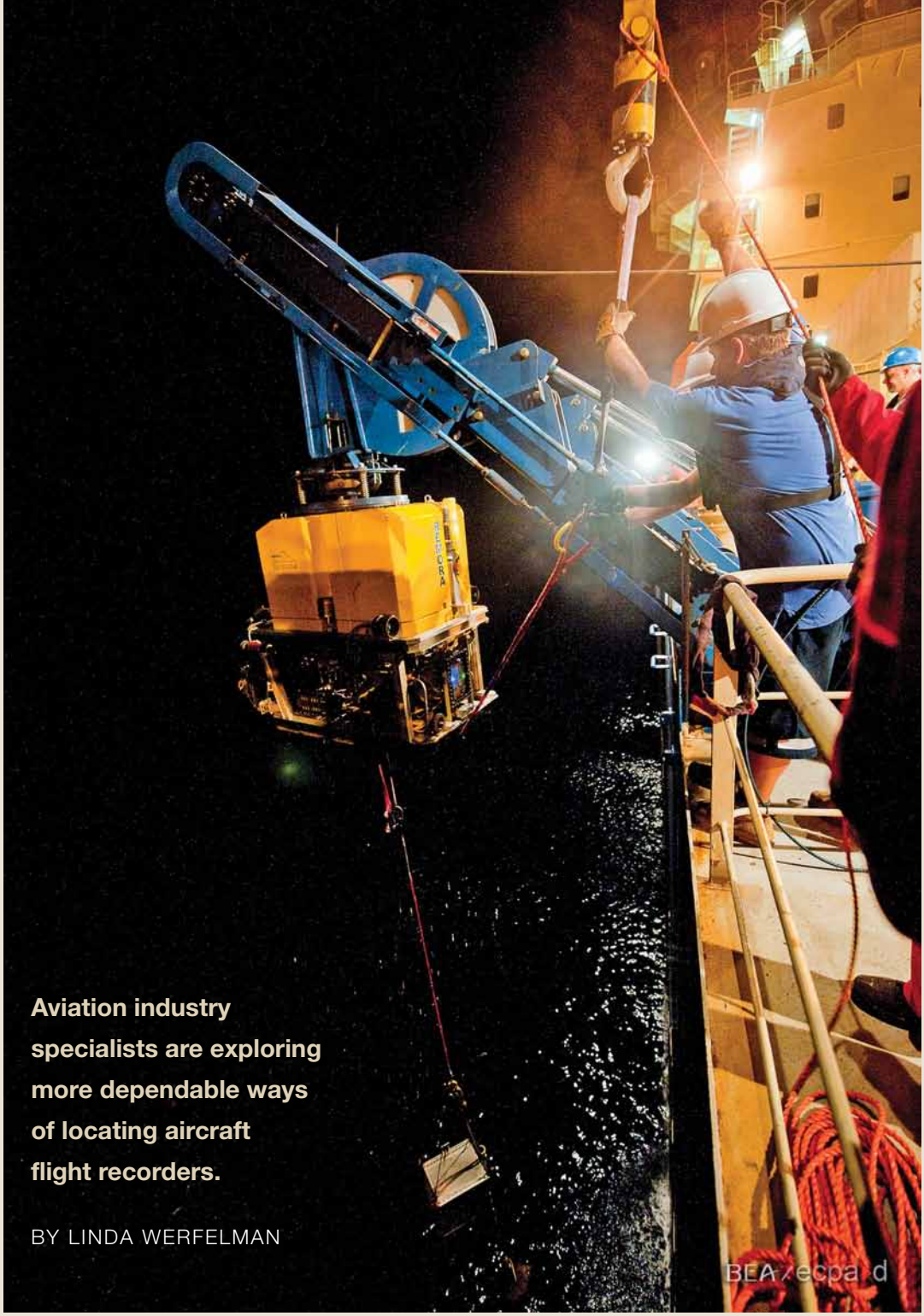
Narrowing the Search



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Aviation industry specialists are exploring more dependable ways of locating aircraft flight recorders.

BY LINDA WERFELMAN

In the nearly three years since an Air France Airbus A330 crashed into the Atlantic Ocean and searchers began a 22-month hunt for the airplane's flight recorders, alternatives have developed to make future searches more efficient or, in some cases, to provide new methods of delivering crucial flight information to accident investigators.

Some of these alternatives involve various uses of streaming data; others focus on new methods of locating an aircraft's black boxes under water or in other difficult terrain.

In the aftermath of the June 1, 2009, crash, regulators have pressed for changes even as the French Bureau d'Enquêtes et d'Analyses (BEA) has continued its investigation into the cause of the accident, which killed all 228 people aboard the flight from Rio de Janeiro, Brazil, to Paris. The BEA has said that its final report would be published by June.[1]

An investigation also was continuing into another accident four weeks later in which a two-month search was required to locate the flight recorders — the June 30, 2009, crash in the Indian Ocean of a Yemenia Airways A310 is under investigation by authorities in Comoros.[2]

The lengthy investigation of the Air France crash has led the BEA to issue a number of safety recommendations, including several involving flight recorders and the transmission of flight data. One of these recommendations calls on regulatory authorities — specifically the International Civil Aviation Organization (ICAO) and the European Aviation Safety Agency (EASA) — to "make mandatory as quickly as possible, for airplanes making public transport flights with passengers over maritime or remote areas, triggering of data transmission to facilitate localization as soon as an emergency situation is detected on board."

A BEA working group studying triggered transmission of flight data noted in a 2011 report that systems exist to accomplish that goal.[3] Some would go further, transmitting more than that minimal amount of data.

"Developing reliable emergency detection criteria is achievable," the report said, citing its study of accidents, incidents and normal flights, which found that "criteria based on a limited set of recorded flight parameters can detect 100 percent of these accidents and incidents."

The report added, "The concept of triggering the transmission of flight data consists of detecting, using flight parameters, [when] an emergency situation is upcoming. If so, transmitting data automatically from the aircraft until either the emergency situation ends or the aircraft impacts the surface."

The report cited several examples of existing systems that transmit data automatically from an aircraft to a ground station for purposes of maintenance or monitoring.

On-Demand Triggered Streaming

Among them is AeroMechanical Services' FLYHTStream, which provides on-demand triggered data streaming, including flight data recorder information and aircraft position information based on global positioning system (GPS) data. The information can be obtained from aircraft operating anywhere in the world.[4]

FLYHTStream can be activated in one of three ways — automatically, when predetermined criteria are met; by a pilot; or by personnel on the ground — and transmits information via Iridium satellites to air traffic control, search and rescue, ground stations, and others, including subject matter experts (Figure 1, p. 28).

"The real-time streaming of critical flight data to the ground creates a virtual black box, allowing the data to be analyzed immediately," the company says. The system automatically notifies key personnel — through urgent emails, text messages or visual/audible notifications on a variety of software systems — and enables communication between pilots and personnel on the ground.

"This … eliminates the chance of key personnel being unaware of an emergency due to misinterpreted maintenance messages that may not indicate the severity of the incident," the company said. "With immediate event reporting and position tracking, it is possible to enhance the provision of appropriate procedures and resources to improve [search and rescue] reaction times."

This type of data streaming is critical, the company said, for "building situational awareness of an airborne event in progress, or for

The flight data recorder of an Air France A330 is pulled from the Atlantic Ocean in May 2011, nearly two years after the airplane crashed during a transoceanic flight. Below, sailors from the Brazilian navy recover wreckage after the June 2009 accident.

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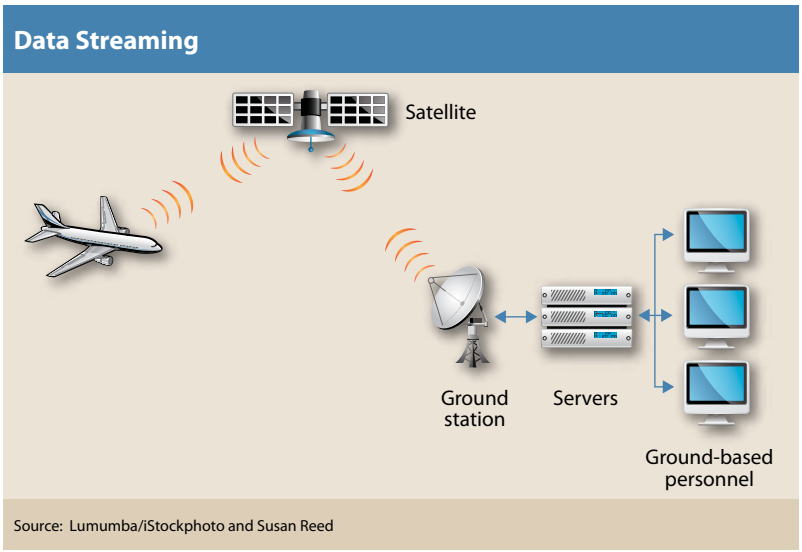

Source: Lumumba/iStockphoto and Susan Reed

Figure 1

post-flight analysis in cases where the FDR [flight data recorder] cannot be recovered."

Real-Time Data Transmission

Star Navigation Systems Group and Astrium Services, a unit of the European Aeronautic Defence and Space Co. (EADS), have developed a satellite communications data service — Airborne Data Service (ADS) — which also provides for real-time flight data transmission to aircraft operators.[5]

ADS uses on-board processors that analyze parameters of actual flight performance and compare them with expected parameters.

"The service uses in-flight equipment that also compresses, encrypts and then securely transmits the data via satellite to Astrium ground stations, which then relay this information to airline operators, enabling in-flight visibility of performance from ground-based facilities," Star Navigation said.

The service provides more information than the more traditional aircraft communications addressing and reporting system (ACARS), which was in use on the Air France A330 and which transmitted a position message and about two dozen maintenance messages during the last five minutes of the flight. The messages "show inconsistency between the measured speeds, as well as the associated consequences," the BEA said in its first interim report on the accident.[6]

The ACARS messages by themselves did not present a complete picture of what happened in the last minutes of the flight.

Both Airbus and Boeing airplanes have onboard systems that monitor and collect maintenance data, then transmit the information via ACARS so that it can be analyzed by maintenance personnel on the ground.

BEA interim accident reports characterized the Airbus Centralized Maintenance System as a tool designed to generate maintenance reports during and after flight "to help airline maintenance departments to anticipate unscheduled maintenance events and to make decisions in the frame of troubleshooting."[7]

Boeing's Airplane Health Management (AHM) uses "real-time airplane data to provide enhanced fault forwarding, troubleshooting and historical fix information to reduce schedule interruptions and increase maintenance and operational efficiency," the BEA said.

The BEA noted that AHM was installed in a UPS 747-400 that crashed Sept. 3, 2010, in Dubai and that it "successfully sent data while the aircraft was still in flight prior to the crash." The accident, which killed both flight crewmembers — the only people aboard — and destroyed the airplane, is still under investigation.[8]

Another system — ECT Industries' Data Transmission System (DTS) and Brite Saver, described as an on-board tracking and data-transmission system that uses the Iridium satellite network — was operating in a Eurocopter AS350 B3 that crashed Oct. 28, 2010, in Antarctica, the BEA said. The wreckage was found 500 m (1,641 ft) from the last position transmitted by DTS. All four people in the helicopter, which operated from a French research vessel, were killed and the helicopter was destroyed.[9]

Underwater Locating Devices

The Air France accident investigation "brings to light the difficulties that can be encountered in localizing, recovering and reading out the recorders after an accident in the sea," the BEA said.

To address those difficulties, the BEA issued other safety recommendations along with an

interim accident investigation report made public in late 2009, calling on regulatory authorities, specifically EASA and ICAO, to "extend as rapidly as possible to 90 days the regulatory transmission time for ULBs [underwater locator beacons, sometimes referred to as underwater locating devices (ULDs)] installed on flight recorders on airplanes performing public transport flights over maritime areas." Currently, ULBs must transmit for at least 30 days.

A companion recommendation, also designed to make it easier for searchers to detect the ULB signal, called on regulators to require the installation of an additional ULB on airplanes involved in public transport flights over maritime areas.

An ICAO panel reviewed those recommendations and related issues and late in 2011 compiled a series of recommendations of its own, based on "a combination of advances in aircraft systems and flight recorder technology, in addition to lessons learned from recent accident investigations," including the investigation of the Air France crash.[10]

Earlier this year, ICAO said it was accepting the recommendations of its Flight Recorder Panel to propose an amendment to Annex 6 — *Operation of Aircraft* calling for 90-day ULB transmissions and installation of additional beacons.

The U.S. Federal Aviation Administration (FAA) also is preparing to implement a change that will extend the minimum required operating life of ULDs to 90 days. The FAA said in a published notice in March that it planned to make the change by March 1, 2014.[11]

ICAO also proposed an amendment to Annex 6 calling for alternate power sources for recorders that would activate automatically to operate a cockpit voice recorder (CVR) for 10 minutes after the CVR's normal power supply is interrupted.

Another proposal would require the use of lightweight recorder systems in smaller helicopters engaged in commercial operations. The amendment was proposed because of the "lack of sufficient data for the investigation of accidents of smaller helicopters involved in commercial operations," ICAO said.

The ICAO Triggered Transmission of Flight Data Working Group continues to review the concept of triggered transmission of flight data, as well as continuous data streaming, to aid accident investigation or help in locating black boxes. The working group was considering not only systems that would result in better use of regular aircraft position reporting through ACARS messages but also through the use of automatic dependent surveillance–contract.[12]

Another subject that remains under discussion within ICAO involves the use of deployable flight recorders, which have been used for years by military aircraft and which have been considered as a way of retrieving aircraft data when wreckage is difficult to access (*ASW*, 8/09, p. 24).

"If an aircraft enters an attitude which is typically unrecoverable, the deployable recorder would be ejected," ICAO said. "The emergency locator beacon would activate to transmit the position of the recorder, and therefore the wreckage, whether on land or at sea. The flight data and cockpit voice recordings would be available as soon as the deployable recorder was recovered."

Deployable recorders were developed in response to concerns voiced in the 1960s by the National Research Council of Canada, which wanted a better way to locate aircraft that crashed in remote areas.

Notes

1. The BEA has said in preliminary reports that in the final minutes of the flight, the airplane's airspeed indications were incorrect, "likely following the obstruction of the pitot probes in an ice crystal environment," and its automatic systems were disconnected. "The airplane's flight path was not brought under control by the two copilots, who were rejoined shortly after by the captain," the third preliminary report said. "The airplane went into a stall that lasted until the impact with the sea."
2. The Yemenia A310-300 crashed off the coast of the Comoros Islands after a flight from Yemen and sank in water up to 4,000 ft deep. All but one of the 153 people passengers and crewmembers were killed, and the airplane was destroyed.
3. BEA Triggered Transmission of Flight Data Working Group. *Technical Document*. March 18, 2011.
4. AeroMechanical Services. *FLYHTStream*. <flyht.com>.
5. Star Navigation. "Star Navigation and Astrium Services Announce Joint Agreement to Provide Airborne Data Services." June 22, 2011.
6. BEA. *Interim Report*, f-cp090601ae. <bea.aero/en/enquetes/flight.af.447/flight.af.447.php>.
7. BEA Triggered Transmission of Flight Data Working Group.
8. Aviation Safety Network (ASN). Accident Investigation. Preliminary–Official. 03 Sep 2010.
9. ASN. ASN Wikibase Occurrence No. 78943.
10. ICAO. *2011 State of Global Aviation Safety*. Montreal. 2011.
11. FAA. "Underwater Locating Devices (Acoustic) (Self-Powered)." *Federal Register* Volume 77 (March 5, 2012): 13174–13175.
12. The FAA defines ADS–C as "a data-link position reporting system, controlled by a ground station, that establishes contracts with an aircraft's avionics that occur automatically whenever specific events occur, or specific time intervals are reached."